

Banister (J. M.)

Compliments of the writer.

Acknowledged

Army Med. School

Rifle Practice in its Relations to Eye-Strain.

BY

J. M. BANISTER, A.B., M.D.,
CAPTAIN MEDICAL DEPARTMENT, UNITED STATES ARMY.

Not Received with

ARMY MEDICAL SCHOOL,
SURGEON GENERAL'S OFFICE
WASHINGTON, D. C.



FROM

THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, *Vol. 18, 1893, CIV,*
NOVEMBER, 1893. *52-567*

RIFLE PRACTICE IN ITS RELATIONS TO EYE-STRAIN.

By J. M. BANISTER, A.B., M.D.,
CAPTAIN MEDICAL DEPARTMENT, UNITED STATES ARMY.

SINCE rifle practice has become a matter of such vital interest to the officers and enlisted men of the United States Army and National Guard, its causative relation to eye-strain has assumed an importance that demands more attention on the part of the medical staff of both services than has heretofore been devoted to it. Hence, it has appeared *à propos* to the writer to attempt a discussion of the matter, pointing out the dangers of the present system so far as the eye is concerned, and advising such a modification of the system as shall be less likely to cause ocular trouble in the future.

This subject will be discussed under the following heads: I. The defects of the present system in its relation to eye-strain. II. In what respects the present system should be modified.

I. THE DEFECTS OF THE PRESENT SYSTEM IN ITS RELATION TO EYE-STRAIN.

1. *As regards the color of the targets.*

The color of the targets, used in known distance firing, is a light buff, the bull's eyes and rings being black. Light is reflected from these targets with almost as much intensity as from a white surface, and no one can realize the dazzling effect produced unless he has faced such a target for several hours under a bright sun. Then, when we remember that the soldier, or officer, as the case may be, is required to aim at this bright surface, and, in the effort to properly adjust the sights of his rifle upon the target, strain his accommodation in the face of the glare, it is a matter for wonder that even more eyes have not succumbed to such cruel and unwise treatment, which sets at utter defiance the laws of ocular hygiene. At most of our frontier military posts, as well as at the majority of the target ranges of the National Guard, the glare during the target season is intense, and especially is this the case at the posts located in Indian Territory, Texas, Arizona, and New Mexico. In the two last-mentioned Territories, the target ranges—with the whole face of the country, for that matter—are destitute of trees, and, during the target season the ground and the targets are of the same buff tint,

LIBRARY
SURGEON GENERAL'S OFFICE

MAR.-8--1898

598.

with scarcely a trace of verdure to relieve the eye. Imagine one practising at a light-buff target under these circumstances, with the bull's-eye dancing in the brilliant sunlight as if bewitched! In the case of the scorers, and of the officers in charge of the practice, the inconvenience resulting from gazing intently at these blazing targets is second only to that experienced by the soldiers engaged in firing. Some officers have attempted to secure protection from the intolerable glare by the use of smoked glasses; but this partial relief is denied the marksman, as he must make use of the full amount of his visual acuteness in order to fire with the best result. Under such circumstances, any masked refractive error is very prone to manifest itself, with the accompanying symptoms of eye-strain. Such treatment is injurious enough to the normal eye, but it is especially hurtful to the hypermetropic or astigmatic organ.

2. *As regards the damage done to the eyes in cases of refractive error.*

In this connection it seems advisable, as a preliminary, to explain, in a manner that may be easily understood by the general practitioner, what is meant by the terms *far point*, *near point*, *visual acuteness*, *accommodation*, *emmetropia*, *myopia*, *hypermetropia*, and *astigmatism*, as a proper appreciation of the meaning of these terms, as well as of the refractive conditions indicated by the last four, is necessary to the clear understanding of the discussion contained in the following pages.

a. The *far point* is that point for which the eye is adjusted when the accommodation is at rest.

b. The *near point* is that point for which the eye is adjusted when the full power of accommodation is called into play. For instance, if an individual can distinguish fine print at a distance of eight inches from the eye, but no nearer, then the *near point* of such an eye is at eight inches.

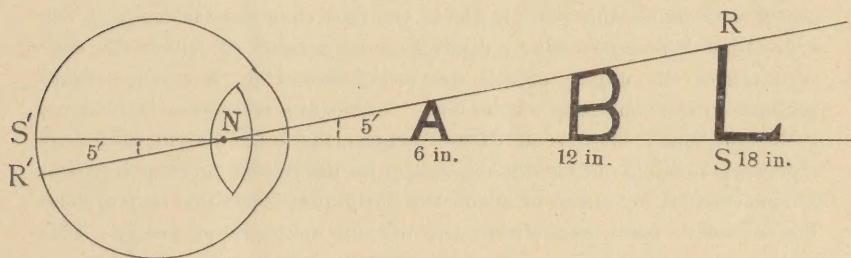
c. *Visual acuteness* is "the power of recognizing form," and the standard adopted by oculists is the power of recognizing an object that subtends an angle of five minutes ($5'$) at the nodal point of the eye.

In Fig. 1, the point N in the crystalline lens is the nodal point, and the rays RR' and SS', which come from the extremities of the letter L, intersect at this point, and the angle RNS ($= R'NS'$) formed by them at N, is the angle subtended by the letter. An eye that can recognize an object which subtends an angle of five minutes at the nodal point is said to possess the normal acuteness of vision. In the figure, it is evident that the other letters, A and B, subtend the same angle. It requires the same degree of visual acuteness to recognize A at 6 inches, B at 12 inches, and L at 18 inches. It must be distinctly understood that the possession of the normal acuteness of vision, as indicated above, does not exclude the possible existence of errors of refraction.

d. *Accommodation* may be defined as the power possessed by the eye

of altering its focus, as may be necessary, for the proper perception of near objects. By the exercise of this power, the refraction of the eye is increased, and near work made possible. Accommodation is due to a little muscle in the eyeball, called the ciliary muscle, which, by its contraction, draws forward the choroid, and thus relaxes the suspensory ligament, or zonula of Zinn, in consequence of which relaxation the inherent elasticity of the crystalline lens is enabled to assert itself with a resulting increase in the convexity of the latter. This increase in the convexity of the lens enables rays of light, emanating from near objects, to be properly focussed upon the sensitive elements of the retina. In the ideal, or normal, eye no accommodation is required for objects at twenty feet or beyond, since, in practical ophthalmology, rays coming from this distance are considered to come from infinity, and, hence, to be parallel, and the theoretically perfect eye is adapted to such rays. This

FIG. 1.



is not true, however, of the eye whose refraction is *not* normal, as will be explained later on. The amount of accommodative effort necessary for distinct vision within infinity (twenty feet), and the distance of the object from the eye are inversely proportional—the shorter the distance the greater the accommodative effort.

The power of the accommodation does not remain fixed through life, but at the age of ten years begins to decline rapidly and regularly until it reaches the zero limit at seventy-five years of age. The following table gives the power of accommodation possessed by the eye at different ages.¹ The letter D means "dioptré," and signifies the refractive power possessed by a lens of one metre (about forty inches) focal length, which is the standard lens of the metric system. This system of designating lenses (metric system) is now almost universally used by oculists, instead of the old inch system.

The excuse for the insertion of this table is the fact that it will be necessary to refer to certain data contained in it at a later phase of this discussion.

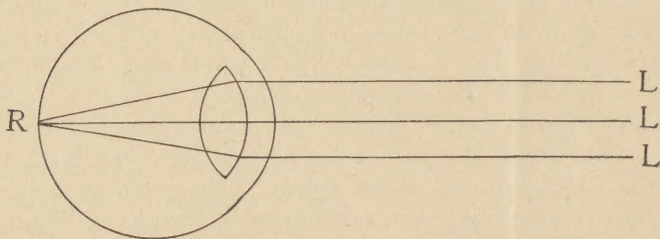
¹ See Landolt: *The Refraction and Accommodation of the Eye*, p. 178.

Years.	Power of Accommodation.
10	14 D.
15	12 D.
20	10 D.
25	8.5 D.
30	7.0 D.
35	5.5 D.
40	4.5 D.
45	3.5 D.
50	2.5 D.
55	1.75 D.
60	1.00 D.
65	0.75 D.
70	0.25 D.
75	0.00 D.

It may be well to state here that this failure of the accommodative power with increasing years is due to the fact that the elasticity of the crystalline lens progressively diminishes, as a result of which the contractions of the ciliary muscle are not followed by a commensurate increase in the convexity of the lens. In certain refractive conditions, to be explained further on, distinct vision, for both distant and near objects, is possible only at the expense of an habitually increased accommodative effort, by means of which the individual is enabled to overcome his refractive error and obtain the normal acuteness of vision. This statement applies to errors of moderate degree in comparatively young subjects.

e. Emmetropia is the theoretically normal state of refraction, and may be defined as that refractive condition which, with the accommodation at perfect rest, permits of the focussing of parallel rays of light upon the

FIG. 2.

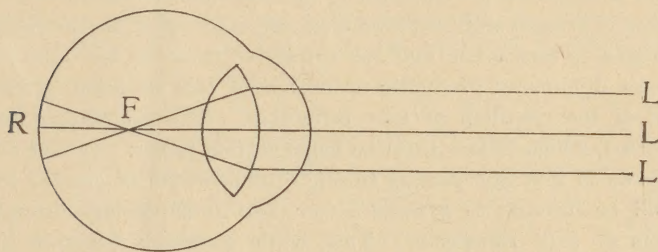


retina, or, in other words, the retina is situated at the focus of the dioptric system of the eye. Such an eye is adapted to *parallel* rays, and the far point is at infinity. This condition is illustrated in Fig. 2. Parallel rays, L L L, are brought to a focus upon the retina at R. In

this and the following refractive conditions it is assumed that the accommodation is at perfect rest, the *static refraction* being meant.

f. *Myopia* (near-sight) is that state of the refraction which causes parallel rays to be focussed *in front of the retina*, or the retina may be said to be *behind the focus* of the dioptric system, as shown in Fig. 3.

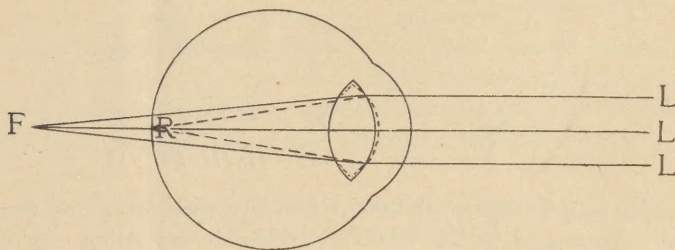
FIG. 3.



In myopia the eyeball is virtually *too long* in its antero-posterior diameter. Such an eye is adapted to *divergent* rays, and its *far point* is at a finite distance *in front of the cornea*, and positive.

g. *Hypermetropia* (far-sight) is that refractive condition in which parallel rays are focussed at a point *behind the retina*. The retina is *in front of the focus* of the dioptric system of the eye. The hypermetropic eye is adapted to *convergent* rays, which do not exist in nature, and hence accommodation is necessary for all distances, both far and near, since by this means alone can parallel or divergent rays be given the proper degree of convergence to be focussed upon the retina. In Fig. 4

FIG. 4.

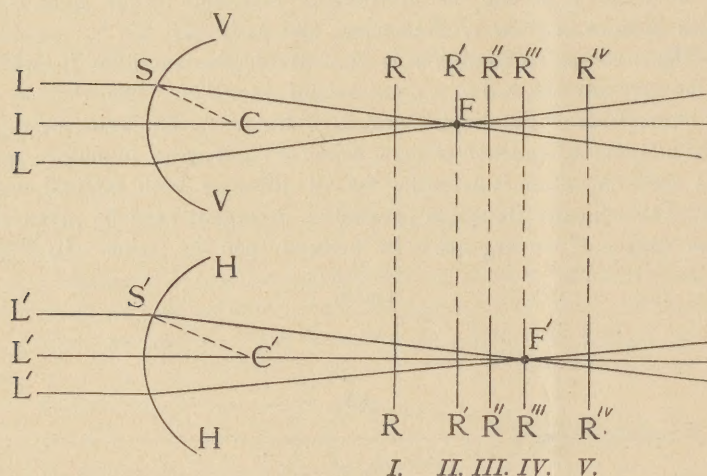


the focus of the dioptric system is at F, a point behind the eyeball, and the parallel rays, L L L, are represented as focussed at this point. The dotted lines show the direction that these rays should take in order to be focussed upon the retina at R, and the dotted curve represents the change in shape of the crystalline lens, under the influence of the contraction of the ciliary muscle, necessary to give the rays, L L L, the required direction.

The hypermetropic eye is *too short* in its antero-posterior diameter, and its *far point* is *behind* the eye, and negative.

h. Astigmatism ($\acute{\alpha}$, privative; $\sigma\tau\acute{\iota}\gamma\mu\alpha$, a point) is that refractive condition in which the different meridians of the refractive apparatus have different powers of refraction, and hence the rays of a cylinder of light entering the eye are not brought to a focus at *one point*. This condition is due to a *difference in curvature of the meridians of the cornea*. The meridians of *greatest* and *least* refraction, called *principal meridians*, are at right angles to each other, and the refractive power of the intervening meridians diminishes gradually from that of the meridian of *greatest* to that of the meridian of *least* refraction. This constitutes *regular astigmatism*, which falls within the scope of this paper. It can readily be understood that rays passing through the meridian of *greatest* refraction will be brought to a focus *sooner* than those passing through the meridian of *least* refraction. This, while seemingly abstruse in the telling, can be readily understood by referring to Fig. 5.

FIG. 5.



Regular astigmatism is subdivided into five varieties, which are individually determined by the relative positions of the retina and of the foci of the principal meridians. From what has been said of the relative positions of the retina and foci of the dioptric system in hypermetropia and myopia, the reader should have no difficulty in comprehending the different varieties of astigmatism as exemplified in Fig. 5 (which is an adaptation from Landoldt).

A single curved surface is here used to represent the refractive apparatus of the eye. Let *VV* represent the vertical meridian, and be the meridian of *greatest* curvature, with the centre of curvature at *C*; parallel

rays ($L L L$) will be focussed by this meridian at F . Now let HH be the horizontal meridian of the same curved surface, and let it represent the meridian of *least* curvature, the centre of curvature being at C' ; then parallel rays ($L' L' L'$) will be focussed by this meridian at F' . It is seen from the figure that the focus F is nearer the refracting surface than is the focus F' . Of course, the planes of the two meridians, VV and HH , are at right angles to each other. Such a condition in the human eye constitutes astigmatism. As before mentioned, the position of the retina with reference to the foci of the two principal meridians determines the special variety of astigmatism in each case.

Returning to our figure, let the screens RR , $R'R'$, $R''R''$, etc., represent the retina as it occupies positions *I*, *II*, *III*, etc. Now, if we place the screen at *I*. (so that it occupies the position indicated by RR), we find that it is *in front of the foci* of both meridians; hence, both meridians are *hypermetropic*, though in *different* degrees, and we have an illustration of *compound hypermetropic astigmatism*. Place the screen ($R'R'$) at *II*, and we find that it *corresponds with* the focus (F) of the *vertical* meridian, which is therefore *emmetropic*, but is still *in front of* the focus (F') of the *horizontal* meridian, which is consequently *hypermetropic*. Here we have an illustration of *simple hypermetropic astigmatism*, in which one meridian is *emmetropic* and the other *hypermetropic*. At *III*. the screen ($R''R''$) is *between the foci* of the two meridians, that of the vertical meridian being in front of it, and that of the horizontal meridian behind it; hence the former meridian is *myopic* and the latter *hypermetropic*, and our figure illustrates a case of *mixed astigmatism*. With the screen ($R'''R'''$) at *IV*., it *corresponds with* the focus (F') of the meridian of least curvature, and is behind the focus (F) of the meridian of greatest curvature, giving us an example of *simple myopic astigmatism*, in which the former meridian is *emmetropic* and the latter *myopic*. If we move our screen (R^IVR^IV) still further from the refracting surface, and let it occupy position *V*., it will be *behind the foci* of both principal meridians, and we have a representation of *compound myopic astigmatism*, in which both meridians are *myopic*, though in different degrees.

To recapitulate :

- I.* represents compound hypermetropic astigmatism.
- II.* " simple hypermetropic astigmatism.
- III.* " mixed astigmatism.
- IV.* " simple myopic astigmatism.
- V.* " compound myopic astigmatism.

I shall now attempt to make an application to target practice of the facts stated in the foregoing remarks upon refraction and accommodation. From what has already been stated, it can readily be seen that the emmetrope, possessed of normal visual acuteness, can, in aiming at the target, see the bull's-eye distinctly with the accommodation perfectly

relaxed, but must make use of his accommodation in order to secure accurate perception of the front and rear sights of his rifle, which are situated at finite distances from the eye. I have determined, by experiment, that the average distance of the eye from the *front* and *rear* sights of the United States Springfield rifle, when firing in the standing or sitting positions, is 110 cm. for the former and 43.1 cm. for the latter—an accommodative effort, therefore, of 0.90 D. being required in the one case, and 2.32 D. in the other. Under proper conditions of ocular hygiene, the emmetropic eye should experience no trouble from constantly bringing this amount of accommodation into play, but, when its use becomes necessary in the face of a dazzling target, matters are decidedly changed. The effect is very similar to that experienced when one attempts to read a newspaper in the bright sunlight, or look fixedly, under the same conditions of light, at a dark object on a whitewashed wall. Such use, even of the normal eye, if continued from day to day, and for an hour or two at a time, for several weeks, will be very apt to bring on serious symptoms of eye-strain; accommodative asthenopia, and congestion of the retina and other structures in the interior of the globe, resulting. Yet this is exactly what the soldier in the United States Army is required to do during the "target season."

In hypermetropia and astigmatism trouble is far more likely to result from this constant firing at the present brilliant target than in the case of emmetropia, just mentioned, for the simple reason that more accommodative strain is required in these refractive conditions.

As before explained, in the case of the hypermetropic eye, accommodation is necessary *for all distances*, the amount of accommodation required in any given case being dependent upon the degree of the refractive error and the distance of the object viewed from the eye. In looking at the target, which the emmetrope can perceive distinctly without use of his accommodation, the hypermetrope is required to bring into play enough accommodation to overcome his error (or, in other words, to give to parallel rays the degree of convergence necessary to their accurate focussing upon the retina) before he can see the bull's-eye. Furthermore, in adjusting his refraction to the sights of his rifle, the hypermetrope must, in each case, make use of this amount of accommodation (*i. e.*, an amount sufficient to overcome his error) over and above that required by the emmetrope under like conditions. In other words, a hypermetrope of 2 D. must constantly make use of 2 D. of accommodation in excess of the amount necessary for the emmetrope.

Much greater strain is placed upon the ciliary muscle in astigmatism than in hypermetropia. Of course, distinct vision without glasses is only possible in the lower degrees of astigmatism, and it is of such degrees that these remarks are made. In order to overcome an astigmatism and secure distinct vision, when such a result is possible, certain segments,

or zones, of the ciliary muscle must contract more strongly than others, producing in this way a condition of artificial compensatory lenticular astigmatism, if I may be permitted the coining of such an expression, which is the converse of the refractive condition of the cornea, and hence neutralizes the effect of the latter. Of course, the crystalline lens becomes most convex in the direction of the most strongly contracting segment of the ciliary muscle. Since the hypermetropic forms of astigmatism are the kinds almost invariably found in soldiers, the following remarks apply to these varieties alone, mixed astigmatism and the forms of myopic astigmatism being excluded.

This neutralizing of the corneal astigmatism by irregular contraction of the ciliary muscle, as above explained, is, in the case of the soldier affected with hypermetropic astigmatism, necessary in order that he may focus parallel rays upon the retina, or, in other words, see distinctly at twenty feet or beyond. Hence, before he can see the bull's-eye, he must thus *overcome his error*, and must, *in addition*, bring into play a general (or regular) contraction of the ciliary muscle, as explained in the case of the hypermetrope, sufficient to enable him to see the sights of his rifle.

From the above description it can easily be understood why the astigmatic soldier is so much more liable to suffer from eye-strain, as a result of rifle practice, than the emmetrope. What was said of the direct effect upon the emmetropic eye of constant firing at the present target applies, therefore, with far greater force to the astigmatic and hypermetropic organs.

So far, it has been assumed that the individuals affected with ametropia have been possessed of sufficient accommodation to overcome their respective errors; but the factor of age must now be taken into consideration. It has already been stated that, owing to a progressive diminution in the elasticity of the lens, the accommodative power diminishes rapidly and regularly from the age of ten years, when it amounts to 14 D., to that of seventy-five years, when it becomes zero. By referring to the table given on a preceding page, it can well be understood how a soldier of twenty or twenty-five years of age, when the accommodative power is 10 D. and 8.5 D. respectively, might easily overcome an error of refraction which would cause great strain of the ciliary muscle, or be insurmountable, by the time he reaches the ages of thirty, thirty-five, or forty years, when the amplitude of the accommodation falls to 7 D., 5.5 D., and 4.5 D.

It is especially in the younger soldiers, who have moderate degrees of refractive error not incompatible with distinct vision under accommodative effort, that we may expect to find asthenopia. By the time these subjects reach the age of twenty-five years any strain of accommodation is almost sure to cause trouble, for by that time the accommodative power

having fallen to 8.5 D., is no longer able to overcome their errors *and leave enough accommodation in reserve for constant work*. It is a fact well understood by ophthalmologists that, for constant use, a certain proportion of the total range of accommodation (about one-third or one-fourth)¹ must be left in reserve, and that all the accommodation can no more be brought into play and kept constantly engaged without fatigue than can any other muscular power.

Now, our soldier of twenty-five years having been during the whole of his previous life accustomed to distinct vision, his visual centres will not brook any dimming of visual perceptions, but demand sharply cut retinal images, and hence the flagging ciliary muscle is spurred on to greater and greater efforts, until severe eye-strain results. In the higher degrees of ametropia (such as would not be likely to be found among soldiers, owing to the examination for enlistment), vision never having been distinct, so much is not required of the ciliary muscle; hence, eye-strain is not so liable to come on. In these cases the visual centres content themselves with the impressions received from the circles of diffusion formed on the retina, and do not realize the need of accurate focussing.

Now, while upon this subject, another element must be touched upon, namely, the part played by the extrinsic eye-muscles in the production of the composite condition called eye-strain. In refractive errors the normal balance between the ocular muscles is not as well sustained as in emmetropia, and, as a consequence, the so-called muscular asthenopia is very prone to occur under conditions of unwise use of the eyes. This condition of muscular asthenopia results in these cases from a disturbance of the normal relations existing between the functions of convergence and accommodation. When this condition is induced in an ametropic individual the state of such a person is far from pleasant. All near work becomes painful; headaches, pain in the back of the neck, dizziness, nausea, and other disagreeable symptoms soon follow any special use of the eyes.

I can speak feelingly on this point, since, in consequence of a season of target practice in 1883, when I stood number one in order of merit in a post garrisoned by headquarters, band, and five companies of the 14th United States Infantry, I developed a condition of muscular asthenopia (insufficiency of the internal recti muscles) which gave me the greatest annoyance for several years. I am a hypermetrope to the extent of 1.50 D., but was not aware of this fact until the eye-strain developed just after the target season mentioned.

Myopia is not frequent among the soldiers of the regular Army; indeed, I have never seen a myopic enlisted man whose error was

¹ See Landolt: *The Refraction and Accommodation of the Eye*, p. 339.

greater than 1 D.; but myopes must be comparatively common among the members of the National Guard, of whom a preliminary physical examination is not usually required. Hence the following statements concerning the effects of "target practice" upon the myopic eye apply especially to the latter organization.

In myopia, vision for distance cannot be improved by accommodative effort, since, even with the accommodation at rest, the dioptric system of the myopic eye is *already too highly refractive*, and rays of light coming from twenty feet or more (parallel rays) are focussed in front of the retina, and then projected upon this structure in circles of diffusion. The myope, therefore, only calls upon his accommodation for distances *within his far point*, which is situated at a finite distance in front of the eye; consequently he habitually makes use of less accommodation than the emmetrope, by the degree of his refractive error. Thus, to read fine print at 33 cm. would require in the emmetrope about 3 D. of accommodation ($\frac{1}{\frac{1}{3} \frac{m}{cm.}} = \frac{100}{33} = 3 \text{ D.}$), whereas, in the case of a myope of 2 D., for instance, only 1 D. would be necessary to do the same work (3 D. — 2 D. = 1 D.); in the case of a myopia of 3 D., no accommodation at all would be needed for this distance (33 cm.), since the individual's *far point* would be at exactly this distance from the eye ($\frac{100}{3} = 33$). In consequence of this diminished use of the ciliary muscle, we find this structure flatter and less strongly developed in myopia than in emmetropia, the circular fibres of the muscle, which are supposed to have most to do with accommodation, being especially defective.¹

A myope of even 1 D. cannot see the bull's-eye distinctly, distinct vision for distance in this refractive condition being only possible with the aid of concave lenses.

The ranks of the National Guard being recruited, as a general thing, from an intelligent class, it is a rule that the myopes of this organization are aware of their ocular defects, and have the same corrected by proper glasses, so that this part of the discussion is narrowed down to the effect of "target practice" upon the myopic eye provided with the proper correction.

Concave glasses, as is well known, call accommodation into play—the stronger the glass the greater the accommodative effort—and frequently myopes, whose accommodative power is not what it should be, cannot stand the full correction, even for distance. Every oculist has frequently in these cases to *under-correct*, and, moreover, even in moderate degrees (about 4 D.), to prescribe still weaker concave lenses for near work, for although, theoretically, myopes of about 4 D. and less are supposed to use this correction for near work as well as distance,

¹ See Fuchs: Text-book of Ophthalmology, pp. 635 and 636.

practically many patients cannot stand the increased accommodative effort necessary in the former case. Hence, such persons are provided with two pairs of glasses—one for distance, and a weaker pair, adapted to the patient's working distance, for near work.

Now, to return to our myopic soldier: suppose him to be moderately myopic, and to wear his full correction in order to see the bull's-eye. Of course, he cannot make use of one pair of glasses for the bull's-eye, and another weaker pair for the sights of his rifle, but must use his full correction for all. Hence, it can well be understood that his poorly developed ciliary muscle may prove unequal to the task when firing at a brilliant target, and accommodative troubles result, as described in the case of the emmetrope. Muscular asthenopia is also apt to occur, but far greater dangers than these menace the myope whose eyes are abused.

Myopia is essentially an acquired condition, being rarely congenital. In the immense majority of cases infants are born hypermetropic. The late Dr. Ely, of New York, examined with the ophthalmoscope the eyes of one hundred infants, and found that nearly all of them had "the short eyeball."¹ The same results have been obtained by other observers. Now, if at birth the eye is, as a rule, hypermetropic, how is it that myopia is induced, or, in other words, what causes the faulty elongation of the globe?

It is the universal opinion of ophthalmologists that the cause of this acquired myopia must be attributed to the constant demands made upon the eyes by near work. In the first place, it is assumed that in such cases there is an ~~ad~~ⁱⁿherent anatomical weakness in the posterior pole of the globe, principally located in the sclera, which fact would render the eyeball prone to elongate in this direction, if subjected to lateral compression, or if from any other cause the intra-ocular pressure should be somewhat increased.

Now, in the production or increase of this ectasis at the weakened posterior pole, no matter in what way this weakness may have been induced, we find the following active agents: 1. The extrinsic ocular muscles, notably the four recti, which, when even in their accustomed state of tonic contraction, press upon the globe, but whose action in this regard is greatly increased in the act of convergence for near work. Moreover, the superior and inferior oblique muscles, encircling the globe as they do, compress it at its equator, and thus press upon the points of exit of some of the *venæ vorticosæ* with a resulting turgescence of these vessels in the choroid, and a consequent increase of the intra-ocular pressure.² 2. The exercise of the accommodation, which is held by

¹ See Valk: *Errors of Refraction*, p. 44.

² See Fuchs: *Text-book of Ophthalmology*, p. 639.

many authorities, notably Landolt, to increase the intra-ocular pressure. 3. A faulty position of the head and body (as in bending forward in near work, or using the eyes while in the recumbent posture) which causes a condition of hyperæmia in the interior of the eyeball, both from increased flow of blood to the organ and from the compression to which the veins in the neck are subjected, with a resulting increase in the intra-ocular pressure.¹ It can also be well understood how harmful the congestion thus induced would be in case the choroid should be diseased or there should be a commencing posterior sclerotico-choroiditis. 4. Improper illumination, either *insufficient* (in consequence of which the work is held too near at hand, and the convergence and accommodation increased to a harmful degree), or *too brilliant* (causing irritation of the eye and rendering the internal structures hyperæmic), or *badly directed*, as, for instance, light shining directly into the eyes, in consequence of the source of light being in front of the individual, which, when conjoined with increased brilliancy, intensifies the bad results of the latter. 5. The traction exercised upon the weakened posterior pole by the optic nerve in strong convergence (Fuchs). In the act of convergence the posterior pole of the elongated globe is turned outward to a greater degree than in the case of the normal eye, and, as a result, the counter-traction of the optic nerve tends to still further increase the ectasis.

Now, place our myopic guardsman, provided with his proper correction, in front of the target and apply the above facts to *his* case. In the *first* place, he has in front of him a bright glaring target, at which he must aim (radically improper illumination); in the *second*, his eyeballs are compressed by the ocular muscles in producing the convergence called for when he attempts to focus the sights of his rifle, especially the rear sight (for, although one eye may be covered by the lid, it will, nevertheless, turn inward from sympathy with the uncovered organ); in the *third* place, by reason of the increased accommodation rendered necessary by the correcting lenses worn, the intra-ocular pressure may still further be increased; and in the *fourth* place, by his head being bent forward and turned sideways (generally to the right), in the act of aiming at the target, the bad results of faulty position (congestion of the intra-ocular tissues, both from increased flow of blood to the interior of the eyeball and from pressure upon the veins in the neck) are induced.

Could our myope be placed under conditions much more unfavorable? If he has a tendency to choroidal disease, this may be precipitated; a slumbering posterior sclerotico-choroiditis may be aroused into pernicious activity, with the result of rendering his myopia progressive; asthenopia, both accommodative and muscular, may be caused; and,

¹ See Hartridge: On Refraction, p. 145.

finally, in older subjects with a high degree of error and fluid vitreous, it is remotely possible that detachment of the retina may ensue.

From what I know of target practice, after over fourteen years' experience as a member of the Medical Corps of the United States Army, I would not advise myopes of a greater degree of error than 2 D. to engage in this military duty.

From what has already been stated, it can easily be understood how the various recumbent positions in long-range firing under the present system of target practice are radically wrong from an eye standpoint. The least objectionable is the *prone position*, since in this the veins in the neck are compressed to a less degree than in the various back and side positions, and hence there is in the former case less consequent congestion of the intra-ocular tissues. The back and side postures are especially injurious, as the reader can easily imagine if he will examine the accompanying illustration, which shows the various permissible positions in target practice as at present conducted in the United States Army. This illustration is copied from a photograph, the work of Captain Sumner Lincoln, of the 10th United States Infantry, to whom I am indebted for the same.

II. IN WHAT RESPECTS THE PRESENT SYSTEM SHOULD BE MODIFIED.

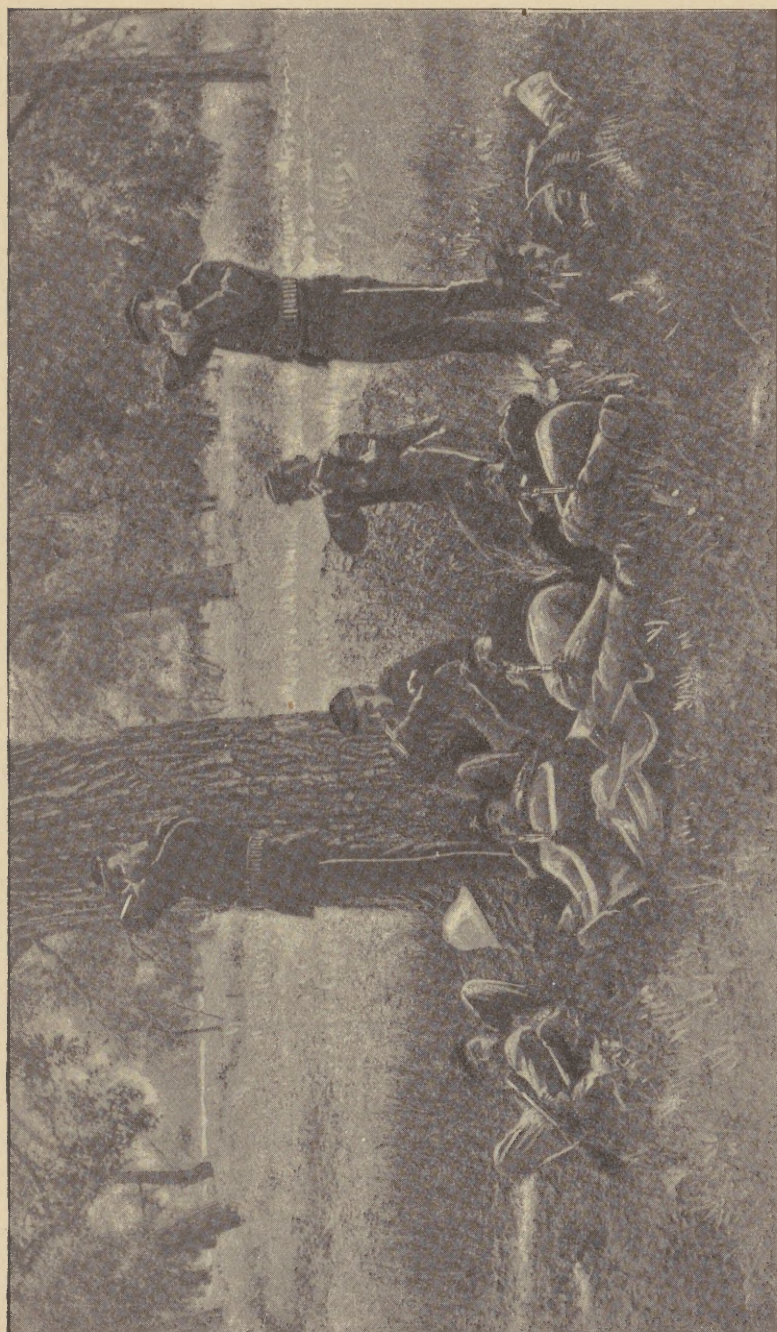
In the first place, the color of the targets should be changed by all means, and the element of glare reduced to a minimum. This can easily be effected by making the *body of the target black* and the *bull's-eye and rings buff*. By this simple change the reflection of light from the target could be almost entirely obviated, since the only visible reflecting surface in this case would be the bull's-eye. Everyone knows that the *black target will absorb light*, instead of *reflecting it*. Another gain in this change would be the greater contrast produced between the color of the target and the face of the landscape, which would be a great advantage at most of our military posts, as before explained.

If any "doubting Thomas" among the members of the shooting fraternity will construct such a target, and place it on a bright day by the side of the present regulation target, he will see the force of these remarks.

It may be claimed as an objection to the proposed target, that such good scores may not be obtained with it as with the one now in use. This objection would prove untenable, since *I have had this matter tested practically at the different ranges*, with the most encouraging results. I believe that better scores can be made with the black target than have heretofore been possible. Furthermore, the relief to the marksman's eyes would be of incalculable advantage.

At present most marksmen aim at the body of the target just below and a little to the left of the black bull's-eye; with the proposed target the front sight of the rifle could be outlined against the bull's-eye itself,

FIG. 6.



which would simply cause a slight change in the elevation of the piece, and in the "windage" and "drift" allowed for.

In the second place, as some recumbent posture seems essential to good long-range shooting, I recommend, for reasons already stated, that the *prone position* be made the sole regulation recumbent position, and that the *back* and *side postures* be excluded. The evil effects upon the eye of faulty position have already been sufficiently discussed in the preceding pages, and it is now only necessary to refer to this fact.

I desire to say, in conclusion, that this paper is not intended as an attack upon rifle practice, but is written with a desire to obviate the evil effects, as far as the eye is concerned, likely to result from the performance of this military duty.

FORT LEAVENWORTH, KANSAS.

The American Journal OF THE MEDICAL SCIENCES.

MONTHLY, \$4.00 PER ANNUM.

WITH 1893 THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES enters upon its seventy-fourth year, still the leader of American medical magazines. In its long career it has developed to perfection the features of usefulness in its department of literature, and presents them in unrivalled attractiveness. It is the medium chosen by the leading minds of the profession on both sides of the Atlantic for the presentation of elaborate Original Articles; its Reviews are noted for discernment and absolute candor, and its Classified Summaries of Progress each month present an epitome of medical advances gleaned by specialists in the various departments. According to unquestionable authority, "It contains many original papers of the highest value; nearly all the real criticisms and reviews which we possess, and such carefully prepared summaries of the progress of medical science and notices of foreign works that from this file alone, were all other publications of the press for the last fifty years destroyed, it would be possible to reproduce the great majority of the real contributions of the world to medical science during that period."

The Medical News.

WEEKLY, \$4.00 PER ANNUM.

BY KEEPING closely in touch with the needs of the active practitioner, THE NEWS has achieved a reputation for utility so extensive as to render practicable its reduction in price from five to **Four Dollars** per annum. It is now by far the cheapest as well as the best large weekly medical journal published in America. Employing all the recognized resources of modern journalism, such as the cable, telegraph, resident correspondents, special reporters, etc., THE NEWS furnishes in the 28 quarto pages of each issue the latest and best information on subjects of importance and value to practitioners in all branches of medicine. Its numerous departments are designed to subdivide and present its material in the most attractive and convenient manner.

In a word THE MEDICAL NEWS is a crisp, fresh, weekly newspaper, and as such occupies a well-marked sphere of usefulness, distinct and complementary to the ideal monthly magazine, THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES.

The Year-Book of Treatment for 1893

Gives a classified summary and review of the real advances in treatment made during 1892 in all departments of the science of medicine. Price, \$1.50; or in combination with either or both the above journals, 75 cents.

The Medical News Visiting List for 1893

Published in four styles: Weekly, dated, for 30 patients; Monthly, undated, for 120 patients per month; Perpetual, undated, for 30 patients weekly per year; Perpetual, for 60 patients weekly per year. The first three styles contain 32 pages of important data and 176 pages of assorted blanks; the 60-patient perpetual consists of 256 pages of blanks. Price, each, \$1.25. In combination with either or both above periodicals, 75 cents. Or, JOURNAL, NEWS, VISITING LIST and YEAR-BOOK, \$8.50. Thumb-letter index for VISITING LIST, 25 cents extra.

LEA BROTHERS & CO., PUBLISHERS, PHILADELPHIA, 706 & 708 SANSON STREET.